SIMULATION OF PALM OIL AND METHANOL MIXING IN STIRRED TANK BY IMPLEMENT A NORMAL AND FRACTAL BAFFLES

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To My beloved parents, MR. HOUSSEIN MOHAMED SMEW & My beloved mum MRS. HAWA MOHAMED SMEW , my beloved brothers and sisters, and all my friends Who has so much faith in me.

Love you always.

I could have never done it without you

I treasure you all

Thank you very much for the loves, support and encouragement.

Life has been wonderfully coloured by you.

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ABSTRACT

Numerical analysis of mixing and dissolution processes is becoming great significant for achieving a process of consideration and optimizing the production. Owing to the rising costs and deficiency of raw materials, "palm oil" processes are presently employed together with standard experimental analysis. Numerical simulations have confirmed to be a valuable instrument for understanding and enhancing industrial mixing problems. However, such simulations are still in the research phase. Even though Computational Fluid Dynamics (CFD) is a powerful and validated method, however, for more complicated applications (e.g., industrial mixing), more work is still required to gain reliable results quickly enough. In this project concentrated on the simulation of two type of tank to compare between normal baffle and fractal baffle in mixing tank to get which one is the best of homogenizing. Approximations were made with respect to improving batch sizes, tank geometry, impeller type, baffle type, and placement and process variables, such as the impeller agitation speed. In addition, the feeding position of the methanol. Finally, a quantitative comparison of different stirring systems and scale-up studies was set.

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LIST OF SYMBOLS

t_m	Mixing time
t_c	cycling time
θ_m,	dimensionless blending time
N_{Re}	Reynolds number
μ	Fluid viscosity
ρ	Fluid density
N	Rotational speed
D	Impeller diameter
σ	Standard deviation
N	The number of data points
X	The mean of the xi
COV	Coefficient of variation
X_i	Mean concentration

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CHAPTER 1

INTRODUCTION

1.1 Definition

Stirring, mixing, blending, homogenization, and emulsification are necessary unit operations in the manufacture of many pharmaceutical, fuels products and are in most cases carried out in agitated tanks made of steel and sometimes equipped with a glass liner. Another significant operation is the dissolution of solids in a liquid phase.1 A large number of studies have therefore focused on analyzing the (multiphase) flow in agitated vessels, as well as numerical and experimental studies. Different flow regimes have been recognized, depending on the range of the Reynolds (Re) number, and also different systems including various impeller types and fractal baffle type system and with normal baffle type system at all. According to, (Thomas Heormann, et al., 2011)

1.2 Biodiesel

Considered Biodiesel an alternative fuel and become more attractive as of late in view of it is ecological profits fuel which is made from renewable biological sources such as

vegetable oils and animal fats. The cost of biodiesel, is the primary obstacle to commercialization of the item .The utilized cooking oils are utilized as crude material, adaption of uninterrupted transesterification procedure and recovery of high quality glycerol from biodiesel by-item (glycerol) are primary cucumber to be considered to minimize the expense of biodiesel. (Fangrui Ma *et. al*, 1999). Malaysia has left on an exhaustive palm bio fuel customized since 1982 and has effectively settled the utilization of palm methyl esters and the mix of transformed palm oil (5%) with petroleum diesel (95%) as a suitable fuel for the transport and industrial parts. At present, the real sympathy toward biodiesel handling is financial achievability. Biodiesel creation will not be supported without tax exemption and subsidy from government; as the generation expense is higher than fossil inferred diesel (Demirbas & Balat, 2006).

1.3 Problem Statement

A mixing tank is one of gadgets in designing commercial ventures that is utilized for the persistent blending of liquid materials. By and large, mixing tank is utilized to blend fluid; however it can additionally be utilized to blend gas streams, scatter gas into fluid or mix immiscible fluids.

In industry, there are numerous sorts of mixing tank have been composed and it is utilized broadly within industry. Notwithstanding, there are numerous mixing tank that have been proposed in industry having unpredictable and muddled in configuration. The sort of mixing tank that ordinarily used as a piece of industry is CSTR, PFR and BR tank. Each of mixing tank has their approach and state of blender that is formed in order to enhance benefit to mix the fluid homogeneously. Meanwhile, each of the arrangements obliges high cost of amassing and need to put a huge amount of time in gathering and station. This exploration study will turn out with straightforward configuration of blending tank and in the meantime having standard effectiveness of blender keeping in mind the end goal to decrease current expense of assembling yet processing same consequences of blending liquid as other blending tank. So as to outline

ideal blender geometries, proper devices and techniques are required to describe the stream conditions and their impact on the blending procedure.

In this study, COV will be connected keeping in mind the end goal to measure for showing the consistency of fixation at a cross area of blending tank. The recreation of blending liquid could be reproduced by utilizing computational liquid element (CFD) programming. The reenactment will anticipate the conduct of liquid course and blending inside the tank. This study will concentrate on recreation of liquid flow and blending inside the Tank at particular separation of investment.

1.4 Objective

This research study embarks on the following objectives:

i. To propose a new approach of fractal concept (square grid fractal) for baffle in mixing tank.

ii. To assess a capability of fractal pattern in mixing process by determining the coefficient of variation (COV).

iii. To make a recommendation for new concept of mixing in tank by using a fractal concept based on square grids fractal.

1.5 Scopes of Study

To conduct this research study, several scopes have been outlined:

i. The simulation is done primarily in mixing tank with two kind of baffle, normal and fractal to get the best mixing by using fluent 14.5 ANSYS.

ii. This study will be implemented by fully numerical simulations.

iii. Three different time steps of 1000, 1200, 1400 and 3600 second will be use in this simulation.

iv. Use the 3 dimension model.

v. The Methanol (CH_4O) will be used in the inlet feed.

vi. The propeller rotation speed is 150 RPM.

vii. The flow will be turbulent with a Reynolds numbers, Re of 4965.

viii. In order to test the quality of the new modeling approach, the numerical simulations will be done by comparing their results of volume fraction with normal baffles simulation to evaluate local values of mixing tank.

CHAPTER 2

LITERATURE REVIEW

2.1 Biodiesel

Bio diesel is a renewable asset serving to decrease the reliance of the economy on constrained assets and imports, make a business sector for ranchers and lessen the measure of waste oil, fat and oil being dumped into landfills and sewers. Moreover, Biodiesel is a light to dull yellow fluid immiscible with water, with high ebullition point and low vapor pressure. It additionally alludes to a diesel – proportionate handled fuel determined from biodiesel sources, (for example, vegetable oils), which could be utilized as a part of unmodified diesel – motors vehicles. It is additionally biodegradable, non-dangerous and regularly transforms something like 60% less net carbon dioxide (Co2) emanations than petroleum – based diesel. Ecological Researchers have reported that global warming change by humanly induced. Its head reason incorporates blazing of fossil powers, for example, coal, oil and characteristic gas via cars which ceaselessly discharges carbon dioxide into the atmosphere (Idusuyi, N. *et al* 2012).

2.2 Mixing process in tank

Liquid blenders cut crosswise over very nearly every preparing industry including the concoction process industry; minerals, mash, and paper; waste and water treating and very nearly every individual methodology area. The specialist working with the requisition and configuration of blenders for a given procedure has three essential hotspots for data. One is distributed writing, comprising of a few thousand distributed articles and a few as of now accessible books, and pamphlets from supplies sellers. Figure :(2:1) shows process mixing tank (James Y. Oldshue, 1983). They have a considerable measure assortment of employments because of the operation adaptability. It could be worked in laminar and turbulent blending administrations. Stirred tank might be utilized for a fluid and gas, a fluid stage mixture, a three stage mixture or fluid with suspended solids mixture.

Figure (2.1): process mixing tank. (James Y. Oldshue, 1983).

It likewise accompanies part of size and utilized focused around the creation and interest. In biodiesel production mixing process is an essential process considered in biodiesel generation. This production is exceptionally intricate and it generates from convection and turbulent trades in a mixing tank (G.r. Kasat *et. al*, 2008).

For blending process, a couple of challengers must to think about on the grounds that this methodology obliged long living arrangement time, high working expense, high vitality utilization and low of preparation proficiency. To comprehend all the challengers, thinks about on biodiesel blend are creating focused around the strengthening innovations. From the research, the analyst found that to attained the best reactor plans, there have a couple of imperative components must to think about including the measure of reactor, tumult framework, hydrodynamic, physical properties of reactants, development material, sharpened steel model, impeller sort, size and speed and confound plan and the systems for hotness expelling and supplying from reactor (M. Hosseini, *et al*, 2012).

2.3 Multiple phase system of the mixing

Multiphase systems are habitually encountered in an assortment of modern methods including a.o. covering, granulation, drying and blend of powers (Fischer Tropsch) and base chemicals. The hydrodynamics of multiphase systems are managed by the movement towards the individual stages and the complex shared collaborations and as a direct an immediate thereof CFD-based modeling of these frameworks has demonstrated so difficult (Niels G. DEEN ,*et al* 2006).

2.3.1 Gas-liquid dispersion

More often than not, to disband the gas in the fluid is the primary motivation behind gas scattering. The gas generally is injected into the tank from the down of reactors, or

someplace else nears the impeller to give the diffusion of gas. Figure (2.2) shows how gas dispersed in the liquid state. (James Y. Oldshue, 1983).

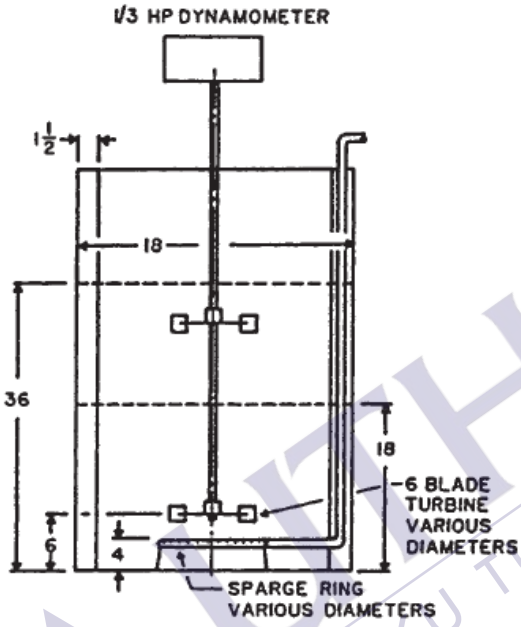

Figure (2.2): Typical arrangement of Rushton radial-flow R100 flat-blade turbine for gas-liquid mass transfer. (James Y. Oldshue. 1983)

2.3.2 Solid-liquid suspension

Generally speaking in a powerful liquid reaction, the reaction was slower than the ordinary and it is happened at the bottom outlet of the tank. Normally, most of the requisition in blending engineering is identified with the suspension of the solids-fluid stage. The solids particles in the tank all around the mixing methodology are denser than the pass on fluid achieving tenacious settling of the particles towards the base of the tank. Along these lines, to stay far from the interminable settling of solids and to procure an adequate mass trade flux throng the powerful surface all around mixing process, the technique is given to keep the solids is suspension (Hinze and J.o, 1975). Solid dissolving issues and insufficient blending for the off-bottom suspension were

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